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THE FRECKLED TREE MONITOR
Varanus tristis orientalis

A male from north-eastern NSW where it was found under rock on a rock outcrop in semi cleared open woodland.

Photo G. Swan

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G. SHEA.

HERPETOFAUNA

Vol. 15 No 1 1983

NEW RECORDS OF A SKINK AND A GECKO FROM WESTERN NEW SOUTH WALES

By G.M. Shea, 13 Residence, Rozelle Hospital, Rozelle, NSW, 20 39 and R. Wells, P.O. Box U30, University of New England, Armidale, NSW, 2351.

The distribution of many Australian reptiles is imperfectly known, primarily due to a lack of intensive field work in many areas, and deficiencies in the knowledge of the precise ecological requirements of many species. The distribution of reptiles in the far south-west of NSW is especially poorly known. Rawlinson (1976) and Greer (1981), for example, show large gaps in the known distribution of *Morethia* species in south-western NSW. Recent field work in this region by the authors has established the presence in NSW of the skink *Cyclodomorphus branchialis* and extended the known NSW range of the gecko *Diplodactylus elderi.*

Two adult male *Cyclodomorphus branchialis* (Australian Museum R105443, R105446) were collected by the authors 12.5km air distance north of Coonbah homestead in 32°53' S, 141°36' E (Grid reference 463937 Menindee 1:250 000 topographic map), on 14 January, 1982, in open mallee woodland (*Eucalyptus socialis, Acacia burkitti* and *Dubosia hopwoodi* association) with an understorey of *Triodia* cf. *irritans* and *Calotis sp. on red sandy soil with scattered pieces of calcrete, forming low sandridges in part (Fig. 1). The weather was mild, with a cool breeze and 0/8 cloud cover. Both specimens were active in separate large (approximately 2 metre diameter) domed clumps of dense live Triodia* at approximately 1730 and 1930hrs EST respectively.

In life, both specimens were dark olive-green dorsally, fading to pale green-white ventrally, with an orange flush over the belly and tail base. The irides were orange and the tongue blue-brown. The ventral spotting of some Western Australian *Triodia*-inhabiting populations (Storr, 1976) was not present.

At the same locality, two adult *Diplodactylus elderi* (AM R105442, R105447) were collected at approximately 1720 and 1940hrs within separate smaller (approximately 1.5m diameter) domed clumps of dense live *Triodia*.

The only previous record of *Diplodactylus elderi* from NSW is a South Australian Museum specimen (R14182) collected by H. Ehmann on 15 April 1974, at 36km north, 3km west of Wentworth, 100km SSE of our locality. This individual was taken in an area of fixed sand dunes with mallee and *Triodia*. Since our work in the Coonbah district, a further specimen of D. elderi (AM R107884) was collected by G. Swan on 4 September 1982 at 165km by road north of Wentworth, via the Silver City Hwy, 13km N of our locality.

Both *C. branchialis* and *D. elderi* appear to be common at the Coonbah locality, as fewer than 10 clumps of Triodia were examined to find our four specimens. Only one individual was found in each clump. This is in agreement with our observations on *C. branchialis* in South Australia and southern Western Australia, where single adults were found in individual clumps, although sometimes in the company of up to four juveniles.

Fig. 1. Habitat at 12.5km N of Coonbah, NSW.

Other species recorded at the Coonbah locality were *Amphibolurus fordi, Egernia inornata and Heteronotia binoei.*

The nearest known populations of *C. branchialis* and *D. elderi* are in South Australia. Both species are commonly recorded from the Renmark region (AM R16111, R16984-87 (*D. elderi*) and R16110 (*C. branchialis*): Renmark (34°10' S, 140°45' E); SAM R16055, R17117 (*D. elderi*) and R15988, R16666A-B, R17125 (*C. branchialis*): Danggali Conser-

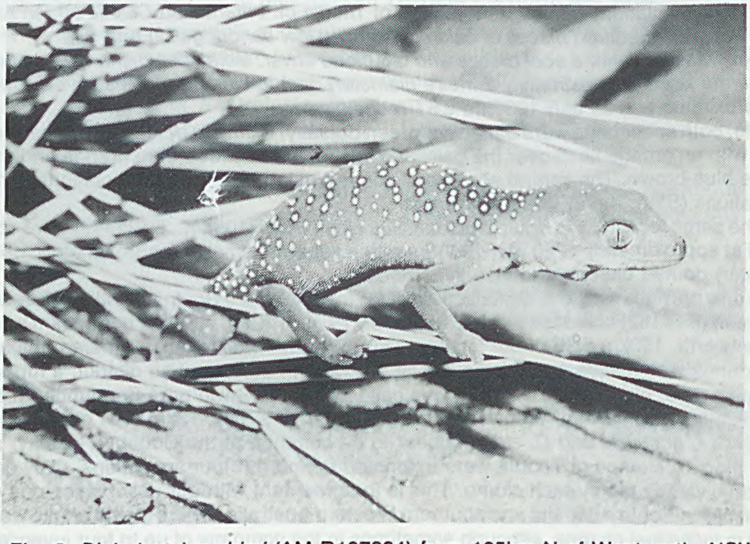

Fig. 2. *Diplodactylus elderi* (AM R107884) from 165km N of Wentworth, NSW.

vation Park (33°34' S, 140°56' E); SAM R16098 (*D. elderi*): Canopus Stn (33°30' S, 140°42' E), Canopus Stn lying 110km SW and Danggali Conservation Park only 100km SW of our locality. Houston (1980) records both species from the Flinders Ranges, the nearest records to Coonbah being SAM R14912 (*C. branchialis*) from Baratta Stn (31°55' S, 139°05' E) and SAM R100909-10, R10949-50 (*D. elderi*) from Paralana Hot Springs (30°11' S, 139°27' E), approximately 260km and 360km NW of Coonbah respectively.

Both species occur to the north of Coonbah, in Queensland (Cogger, 1979; Ingram and Covacevich, 1981). However, neither species is known to occur to the south of the Murray River (Rawlinson, 1966; Baverstock, 1979) which may form a barrier to dispersal south. Cogger and Heatwole (1981) comment on the importance of rivers as barriers to reptile dispersal.

Comparison of a series of 11 Queensland C. branchialis (AM R72028-37, R73325, all 92km W of Winton, in 22°14' S, 142°11' E), 10 eastern South Australian specimens (SAM R10943-44, R100956-57, Paralana Hot Springs; R14912; R15988; R16666A-B; R17125 and AM R16110) and our two NSW specimens (Fig. 3), suggests that the NSW population is more closely related to adjacent South Australian populations than to the more distant Queensland populations. A similar relationship is assumed for *D. elderi*.

Fig.3.
Comparison of *C. branchialis* from N.S.W., Qld and eastern S.A.

	MB	SC	SL	SOSL	NU
Qld (N=11)	24-27 (24.8)	73-76 (75.0, N=5)	14-16 (14.9)	5-6 (5.1)	2-5 (3.3)
N.S.W. (N=2)	28	68-70	12-14	6	0-2
S.A. (N=10)	24-28 (26.2)	67-74 (70.1, N=7)	11-15 (12.6)	5-6 (5.7)	1-4 (2.7)

MB = midbody scale rows, SC = subcaudal scales (from the anteriormost scale approximately equal in size to adjacent lateral caudal scales, to the terminal spine), SL = subdigital lamellae, SOSL = subocular supralabial, NU = nuchals. Values are range followed by mean (in parentheses).

Triodia tussocks provide a cool, moist microhabitat in xeric environments, and possess a distinctive herpetofauna (Keast, 1959; Warburg, 1963; Cogger, 1974). Within NSW, this fauna is represented by at least six species: *D. elderi, C. branchialis* (inland populations of Storr, 1976), *Delma australis, Amphibolurus fordi, Ctenotus atlas* and *Echiopsis curta*, the latter four species having crossed either the Darling or Murray Rivers to reach central NSW. Two further *Triodia* inhabitants may also occur in NSW. *Delma nasuta* occurs in the Flinders Rangers in SA (Houston, 1980), while *Hemiergis millewae* is known from the Flinders and Olary Ranges in SA and from north-west Victoria (Coventry, 1976; Houston, 1980).

While officers of the NSW National Parks and Wildlife Service and the State Herbarium are currently surveying the flora of the Eucalypt-*Acacia-Triodia* assocations south of Broken Hill, the habitat present at our Coonbah locality is not known to be currently represented in any flora reserve in the area (I. Pulsford, pers. comm.). Continued survival of *C. branchialis* and *D. elderi* in the state may be dependent upon reservation of areas of *Triodia-mallee* habitat west of the Darling River.

Acknowledgements

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Allen Greer brought the problem to our notice. Paul Green and Peter Lang of the Botany Dept, University of Adelaide, identified our somewhat crushed plant specimens.

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NOTES ON GROWTH OF THE MAJOR SKINK (*Egernia frerei*) IN CAPTIVITY.

Chris Banks, Keeper-in-Charge (Reptiles); Royal Melbourne Zoo, P.O. Box 74, Parkville, Vic. 3052.

A pair of Major skinks were donated to the Royal Melbourne Zoo on 1 April 1979. The female came from the Cairns region of north-east Queensland and had an olive head, yellow/olive belly and a broad, black lateral stripe. The male had pale bluish speckling on the throat, clearly defined thin black dorsal and lateral stripes, and came from the Murwillumbah area of coastal N.S.W.

Both lizards were sexed by probing soon after arrival with the following results:-

Male — 12 sub-caudals and 35mm
Female — 5 sub-caudals and 15mm

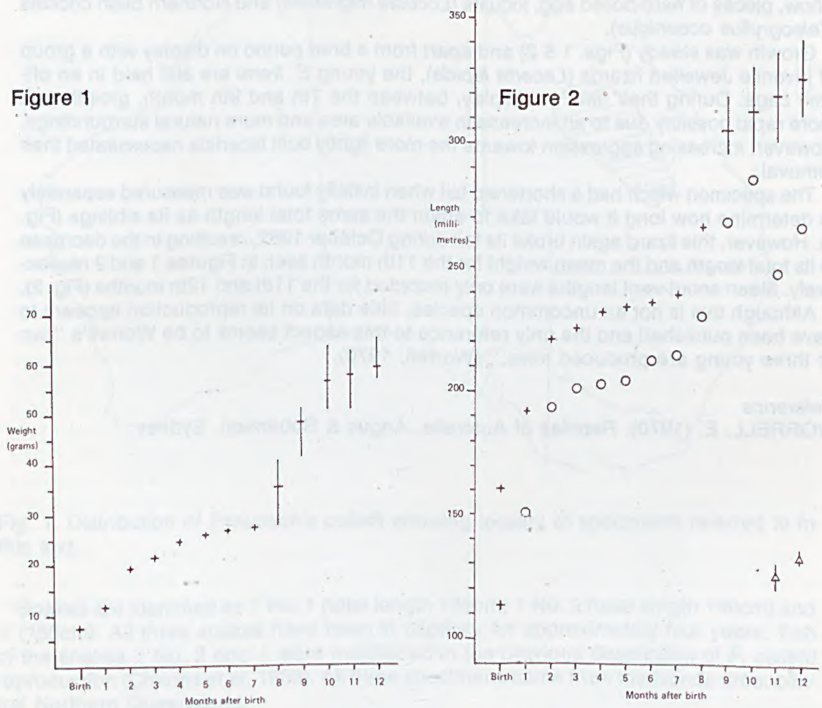

Figure 1. Weight increase for *E. frerei* from birth to 12 months of age. Mean weight only is given for birth — 7 months. For 8-12 months, vertical bar denotes range and horizontal bar denotes mean.

Figure 2. Length increase for *E. frerei from birth to 12 months of age.* + — total length for 2 full-tailed specimens (mean only is given for birth — 8 months; for 9-12 months, vertical bar denotes range and horizontal bar denotes mean). ○ — mean total length for short-tailed specimen. △ — mean snout-vent length for 3 specimens at 11 and 12 months of age (vertical bar denotes range).

Following probing they were placed on display in a large mixed exhibit containing a variety of fresh-water tortoises as well as two Land mullets (*Egernia major*) a pair of Eastern water dragons (*Physignathus l. lesueurii*) and a single Northern bluetongue (*Tiliqua scincoides intermedius*). The *E. frerei* settled in well and were soon moving freely around the exhibit.

Although no courtship or mating behaviour was observed, three new-born lizards were found in the exhibit on the morning of 7 December 1981, 32 months after the adults arrived. The young lizards were immediately caught and transferred to an off-limit aquarium. No further individuals were detected. Apart from one specimen having lost some of its tail, they were in perfect condition and resembled the female in colouration and markings except that the black lateral stripe was broken by small, cream spots and the ventral surface was a pale greyish/brown with darker flecking.

Feeding commenced three days after birth with the young lizards taking almost anything that was offered — chopped fruit and soft vegetables, minced meat, moistened Puppy Chow, pieces of hard-boiled egg, locusts (*Locusta migratoria*) and Northern bush crickets (*Teleogryllus oceanicus*).

Growth was steady (Figs. 1 & 2) and apart from a brief period on display with a group of juvenile Jewelled lizards (*Lacerta lepida*), the young *E. frerei* are still held in an off-limit cage. During their time on display, between the 7th and 9th month, growth was more rapid possibly due to an increase in available area and more natural surroundings. However, increasing aggression towards the more lightly built lacertids necessitated their removal.

The specimen which had a shortened tail when initially found was measured separately to determine how long it would take to attain the same total length as its siblings (Fig. 2). However, this lizard again broke its tail during October 1982, resulting in the decrease in its total length and the mean weight for the 11th month seen in Figures 1 and 2 respectively. Mean snout-vent lengths were only recorded for the 11th and 12th months (Fig. 2).

Although this is not an uncommon species, little data on its reproduction appears to have been published and the only reference to this aspect seems to be Worrell's "two or three young are produced alive." (Worrell, 1970).

Reference

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FURTHER NOTES ON CAPTIVE BREEDING OF THE COLLETT'S SNAKE *(Pseudechis colletti)*

Neil Charles, 8 Mahonia Street, Bellbowrie, 4070. Qld

The collett's snake (*Pseudechis colletti*) is a somewhat rare, large, elapid snake, that inhabits the black soil plains of central Queensland. (Refer figure 1). Oviparity has recently been recorded as the mode of reproduction for this species (Charles, Watts and Shine, 1983). The following data confirm oviparity, and provide further information on fecundity, mating behaviour and incubation periods.

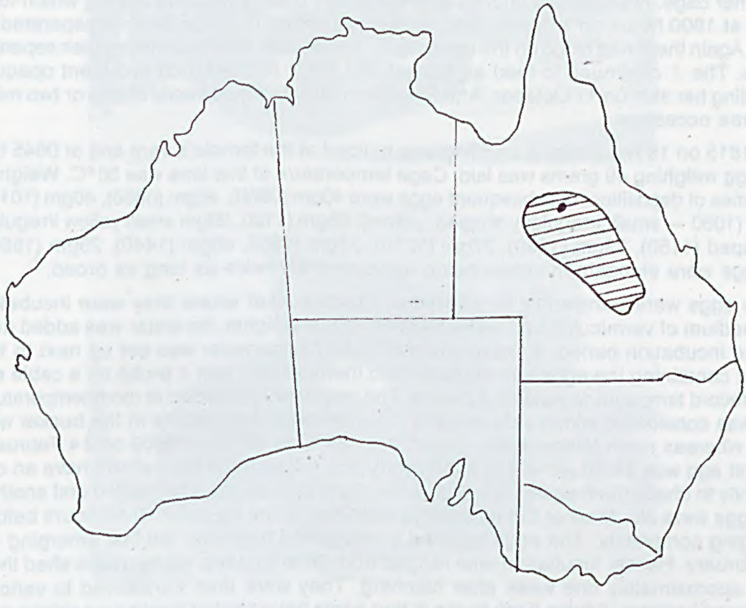

Fig. 1. Distribution of *Pseudechis colletti* showing locality of specimens referred to in this text.

Snakes are identified as ♀ No. 1 (total length 149cm) ♀ No. 2 (total length 140cm) and ♂ (185cm). All three snakes have been in captivity for approximately four years. Two of the snakes ♀ No. 2 and ♂ were mentioned in the previous description of *P. colletti* reproduction (Charles et al, 1983). All three specimens came from the Nonda area, central Northern Queensland.

The snakes were maintained in glass-fronted wooden cages. Newspaper was used as substrate, and hiding boxes and water bowls were provided. The snakes were fed at 10-14 day intervals on rats or mice. A natural (Brisbane) photoperiod was offered and artificial heat from infra-red lamps was provided during winter for two hours in the morning (0500 to 0700 hours) and afternoon (1600 to 1800 hours). The three specimens were maintained separately prior to mating.

At 2000 hours on 6 August 1982 ♀ No. 1 was placed with ♂. The male immediately came out of his hide box and began to follow the female around the cage. He crawled on top of the female and started the usual rippling and jerking motions and at the same time hooked his tail under hers, positioned the vents and inserted his right hemipenis. Cage temperature was recorded at this time at 24°C. They were still joined at 2200 hours

and when checked again at 2300 hours were still incopula and bleeding was noticed from the female's cloaca.

The snakes were not checked again until 0630 hours by which time they had separated. The ♀ was returned to her cage, and on 9 August she ate two mice.

She was again introduced to the cage occupied by ♂ on 24 August at 1300 hours (cage temperature again 24°C). The snakes mated immediately and again blood was noticed on the newspaper. They separated at 1445 but were found joined together again at 1515 and mating continued until 2139 when they separated and the ♀ No. 1 was again returned to her cage. No food was offered to either snake prior to the third mating which took place at 1800 hours on 1 September. Again they mated immediately and separated at 2240. Again there was blood on the newspaper. The snakes were returned to their separate cages. The ♂ continued to feed as normal and the ♀ refused food and went opaque, shedding her skin on 11 October. After shedding she ate small meals of one or two mice on three occasions.

At 1615 on 18 November a swelling was noticed at the female's vent and at 0645 the first egg weighing 49 grams was laid. Cage temperature at this time was 26°C. Weights, and times of deposition, of subsequent eggs were 40gm (0800), 46gm (0856), 40gm (1010), 18gm (1050 — small, irregularly-shaped, yellow), 56gm (1120, 20gm small yellow irregularly shaped (1150), 33gm (1230), 37gm (1310), 37gm (1355, 40gm (1440), 28gm (1550). All eggs were elongate in shape being approximately twice as long as broad.

The eggs were transferred to a sealable plastic bucket where they were incubated in a medium of vermiculite and water mixed to equal weights. No water was added during the incubation period. A maximum-minimum thermometer was set up next to the bucket containing the eggs and an electronic thermometer with a probe on a cable set up to record temperature inside the bucket. The eggs were incubated at room temperature as it was considered within safe margins. The average temperature in the bucket was 27°C whereas room temperature ranged from 24°C to 30°C. At 0600 on 14 February the first agg was found slit with a head protruding through the slit. I didn't have an cpportunity to check them again until 1730 when the first juvenile had emerged and another two eggs were slit. Most of the hatchlings remained in the eggs for 10-12 hours before emerging completely. The eggs hatched in staggered intervals, the last emerging on 17 February. Hence, incubation time ranged from 88 to 91 days. All neonates shed their skins approximately one week after hatching. They were then transferred to various registered keepers. Advice back to me is that some have started feeding on skinks and some accepted pink mice straight away.

Reproduction data on the second female (♀ No.2) show many similarities. She shed her skin at midnight on 9 September 1982 and was immediately placed with the ♂. Copulation commenced immediately and the snakes were still "in copula" at 0700 on 19 September and didn't separate until midday. Cage temperature at this time was noted at 26°C. The snakes were reintroduced on the 3rd September at 2300 hours when the third mating took place. Slight bleeding was noted in all three matings. ♀ No. 2 fed voraciously through the pregnancy.

When she was inspected in her hide box at 0635 on 14 November, two eggs had already been laid. One was discoloured as described with ♀ No. 1's clutch. This egg weighed 28 grams. It was dissected and no embryo was discerned. Egg No. 2 weighed 40 grams. Another five eggs were laid during the next hour and a half. These eggs ranged in weight from 38 grams to 43 grams. This female's clutch for the previous year was also seven.

The eggs were incubated in a similar method to the clutch of ♀ No. 1, however, room temperature varied from 26°C-33°C and the average temperature with the eggs was 30°C. The first egg slit on the morning of 6 March 1983 and the snake had emerged by 1800 hours when another three eggs slit. All snakes had hatched by the evening of 7 March 1983. Hence, incubation time was 82-83 days. It should also be noted that none of the usual pre-hatching wrinkling eggs occurred with either clutch.

Fig. 2. Upper photo: Copulation of ♀ No.1 and ♂; middle photo: Oviposition by ♀ No.1; lower photo: hatchling *P. colletti* emerging from egg (photo M. Peteson).

Table 1. Measurements and weights of newborn *Pseudechis colletti,* taken within 48 hours of birth. Sex determined by gentle probing with fishing line.

Hatchings from ♀ No.1

	Weight (gm)	Sex	Snout-vent length (cm)	Tail length (cm)
1	28	♀	32	4.5
2	30.5	♂	33.5	5
3	21	♀	32.5	4.5
4	22.5	♂	33	4.5
5	20	♂	31.5	4.5
6	30.5	♂	35	6
7	29	♀	31	4.5
8	31	♀	32.5	4
9	31	♂	33	5.5
10	20	♂	31.5	4.5

Hatchings from ♂ No 2

	Weight (gm)	Snout-vent Sex	Tail length length (cm)	(cm)
1	31	♀	33	5
2	22	♀	31	4
3	30.5	♀	32	5
4	30	♀	33	4.5
5	30	♀	31.5	4.5
6	32	♂	33	5

Discussion

I feel that my observation of both females bleeding during copulation deserves further investigation as I have been unable to find any documentation of this occurance. I have observed similar instances of females bleeding during copulation in *P. australis, P. guttatus, P. porphyriacus* and *Python amythestinus.* The appearance of the blood would possibly be more obvious to me because of the newspaper substrate being absorbent whereas soil or gravel may disguise the blood.

The cause of the bleeding could possibly be attributed to the large spines of the hemipenis of male snakes of certain species.

Acknowledgements

I would like to thank Dr Richard Shine of Sydney University for his assistance and supervision, Mr Merv Parker of the Queensland National Parks and Wildlife Service for his support and co-operation throughout the project and Kaye Nalder for typing my notes.

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A RECORD OF REPRODUCTION IN CAPTIVE *DELMA AUSTRALIS* AND *D. FRASERI* *(Lacertilia: Pygopodidae)*

By Brian Bush, P.O. Box 192, Esperance, Western Australia.

During the first week in December, 1982 3 gravid *Delma australis* Kluge and 1 gravid *D. fraseri* Gray were collected at Lort River, W.A. in lat. 33°45' S, long. 121°15' E and retained until oviposition was observed on 19, 22 and 25 December respectively in *D. australis*, and on the 23 December in *D. fraseri.* All clutches contained 2 eggs which were weighed and measured along with the repsective females immediately following parturition (see Figure 1). For method of incubation see Bush (1983). Incubation temperature = 28°C ± 4.

Within 24 hours of commencing incubation, 4 eggs comprising a clutch each from two of the *D. australis* specimens were found to be badly desiccated and therefore removed for perserving. It is believed that these eggs were infertile. The remaining two clutches (1 clutch/species) absorbed moisture and increased in size. On 12 February, 1983 the eggs were measured for size, but not weight; as my previous attempts at laboratory incubating the eggs of these species had been unsuccessful, I was reluctant to disturb this sample. Although all the eggs had increased noticably in size, one *D. australis* egg increased by an estimated 109%, and had changed from an elongate, oval-shape with straight sides to a bean-shape with curved, parallel sides. For increases in the other eggs see Figure 1.

	Female		Egg					Hatchling	
Species	S-VL (mm)	Weight (mm)	Size (gm)	weight (gm)	12 Feb.★ Size	%Inc	Incubation period (days)	S-VL (mm)	Weight (gm)
australis A	73	1.41	14×	0.33					
			13×5	0.29					
B	75	1.43	14×4	0.29	15×6	60			
			13×5	0.30	17×8	109	66	31	0.26
C	75	1.30	16×5	0.19					
			16.5×5	0.20					
D. fraseri	115	8.45	22×8	1.14	23×10	31	77	43	0.72
			23×7-8	1.04	27×9-11	57	74	45	0.96

Figure 1. Female, egg and hatchling data for *Delma australis* and D. fraseri.
* This date in itself is not significant apart from being the only day during incubation that the eggs were disturbed so that measurements could be taken.

On 25 February the bean-shaped *D. australis* egg hatched; the other failed to, and when dissected several days later it was found that the embryo had died well prior to full term development. The hatchling's colour and pattern (in this species all markings are restricted to the throat region) was the same as in adults.

The *D. fraseri* eggs hatched on 6 and 9 March respectively. These hatchlings were vividly marked with black, white and reddish-orange on the head and nape (Fig. 2). In adults these markings are barely discernible, and in many individuals they have faded completely.

All hatchlings were weighed and measured for snout-vent length as soon as they had cleared the egg-case. Measurements of weight were obtained using mechanical balance-scales calibrated in 0.1 grain (5 0.oo65 gram).

Figure 2. *Delma fraseri* hatchlings.

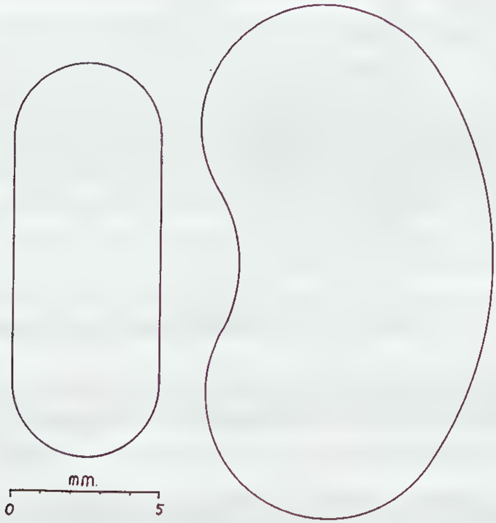

Figure 3. The *Delma australis* egg mentioned in text. On the left as it was at parturition, and on the right as it was after 53 day's incubation.

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Record of the Skink *Leiolopisma acrinasum* Hardy from a Boulder Beach on Resolution Island, New Zealand.

Geoffrey B Patterson, Zoology Department, University of Otago, Dunedin New Zealand.

On 22 and 23 May 1982 four Fiordland skinks, *Leiolopisma acrinasum*, were found at Disappointment Cove on Resolution Island (area [5] 21,000 ha), near the entrance to Breaksea Sound, Fiordland (45°38' S, 166°30' E). The first specimen, a juvenile, was formed approximately 15cm below the surface of a mobile boulder beach at high tide mark, and two larger individuals were found by excavating a nearby area of beach. The pit thus found measured 30cm deep by 40cm wide. A large adult female was found 4m from this depression under a layer of stones also at high tide level. This specimen (Otago Museum Catalogue No. A83.16) measured 88mm from snout to vent, and had a mature ovum in each ovary. The remains of a large amphipod were found in the stomach, together with several nematode parasites identified as *Hedruris minuta* (based on the descriptions in Andrews (1974)) and a *Parathelandros* species (W.C. Clark; pers. comm. 1984).

This is the first confirmed record of *L. acrinasum* on this island. An unidentified skink was seen on the shore of Five Fingers Peninsula in 1971, and *L. acrinasum* has been recorded from 11 islands near Resolution Island (Thomas, 1982). The discovery of this species at Disappointment Cove is significant because the island supports stoats (*Mustela erminea*) (K. Morrison; pers. comm. 1982) and wekas (*Gallirallus australis*) (Bremner et al, 1982), which prey on lizards (King and Moody, 1982, Thomas, op. cit.). Also, a large rat population persisted until about 1903, when it declined greatly, probably due to predation by stoats (Taylor, 1978). Thomas (op. cit.) noted that *L. acrinasum* had been found only on islands which were apparently free of rats, stoats and wekas, inhabiting shoreline rock platforms where it would be vulnerable to these predators. The skink population at Disappointment Cove, however, has survived the depredations of rats, stoats and wekas, no doubt because of the extra protection of the mobile boulder beach habitat.

Acknowledgements

The author would like to thank the Fiordland National Park for making this paper possible, Professor W.C. Clark for identifying some of the parasites, and confirming the identification of the others, and Associate Professor C.W. Burns and Mr B. Thomas for checking the manuscript.

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A Note on Longevity in *Egernia cunninghami* with a New Captive Longevity Record

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During the first week of September, 1968 I visited Sydney, Australia as an American serviceman on R&R from South Vietnam. A total of six days were spent in Sydney during which field collecting was undertaken in the vicinity of Ku-Ring-Gai Chase National Park.

Two large, adult Cunningham's skinks (*Egernia cunninghami*) were collected along with other local species.

The group of lizards collected were subsequently returned to Vietnam with me, where they were maintained for approximately two months then transported to the United States arriving October 31, 1968.

At the date of this writing (June 26, 1984) one of the Cunningham's skinks is still alive, the second one having died only about three years ago. The sex of both animals is undetermined.

The surviving lizard was the larger of the two adults taken and had a badly regenerated tail upon capture, which begins just below the tail base. This condition has not improved and no additional growth in the tail has been observed. Some muscle deterioration has been evident in this specimen for the last several years, as the animal no longer moves with the quickness or agility it once displayed. It continues to feed readily when food is presented, however.

Bowler (1977) cites 10 years, 5 months as the longevity record for a wild caught specimen of *E. cunninghami* which was apparently housed at the Saint Louis Zoo in Missouri, U.S.A. Beyond that, I have been unable to locate any additional data on longevity in this species in any of the references consulted. Bustard (1970 — p. 126) states that R.E. Barwick's study of 1965 determined sexual maturity to be reached in the sixth year. The Barwick study is unavailable to me and has not been consulted. As previously stated, the specimen here discussed was a large (sexually mature?) adult at the time of capture. Assuming this specimen was sexually mature on the capture date and adding the subsequent 15 years, 1 month of captivity, this animal is certainly 21 years plus in age. It is reasonable to assume an even greater age, since age at capture is unknown, but quite probably greater than six years. Gerry Swan (1983) has also been unable to obtain any literature reference to such longevity in this species.

The implication of this experience suggests that lizards of the genus *Egernia* (and *E. cunninghami*, at least) are capable of attaining a much greater age than may previously have been supposed.

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THE ARTIFICIAL INCUBATION OF LACE MONITOR *(Varanus varius)* EGGS

By Kevin Markwell, 168 Main Road, CARDIFF. 2285

On the morning of the 17th December, 1980, four *Varanus varius* eggs were discovered lying on the ground in a goanna enclosure at a wildlife park at Maitland NSW, (32°44'S, 151°34'E). The eggs were not meaured, but one egg was much smaller than the others and felt solid. This egg was later discarded. The eggs were placed in a plastic ice cream container containing Vermiculite as a support medium. The eggs were half buried and several moist paper tissues were then placed over the eggs. The container (which was covered with a lid) was placed on top of a domestic hot water system heater. This kept the eggs at a temperature higher than the ambient temperature but fluctuations did occur.

After three weeks another egg had solidified and was discarded. The remaining two eggs apppeared to be doing well. The eggs were sprayed with water every few days and were occasionally handled during inspection. By May, 1981 the eggs were removed from their position on the hot water heater and were placed on top of an oil heater in my lounge room. The heater was turned on only during the night, so the eggs experienced a wide range of temperatures. The eggs were allowed to dry out slightly during the winter, but by September the moisture level was increased. By now I had almost given up on the eggs, but due to their good appearance I decided not to open them.

On the 30th October, 1981 (forty-five weeks after the eggs had been laid) at 12.00pm, one dead newly hatched monitor was found lying near its egg. The lizard was still attached to the egg by its yolk sac.

Measurements : Egg 6.9cm long by 3.95cm wide.
Dead Hatchling
Tail Length : 15.7cm
Total Length : 26.0cm

With renewed hope I placed the container with the remaining egg under a 60 watt light globe and left it for about an hour. At 1.45pm, the container was opened and at precisely this moment a small amount of fluid flowed out of a 3cm slit in the egg and in a matter of seconds a young monitor emerged, with only the tail remaining inside the egg. It lay alongside the egg for about 30 minutes breathing heavily and it appeared exhausted. It's tail then emerged from the egg and the lizard began exploring the container, dragging the egg (which was still attached by the yolk sac) around with him.

Within the next few minutes, however, the yolk broke close to the belly. The lizard was then placed in a glass tank where it spent the next hour scratching at the base of the tank. Both hatchlings appeared to be similar in colour and markings with chocolate brown and yellow bands and an overall bluish tinge. The tails ended in a black tip.

Measurements : Egg 7.00cm long by 4.1cm wide
Live Hatchling
Tail Length : 17cm
Total Length : 28cm

Discussion

The incubation period for these eggs was 317 days, which can be compared with the data for Sand Goanna (*V. gouldii*) eggs reported by Barnett (1979, pp21-22). Three of these eggs were incubated at a constant temperature of 30-32°C and took between 169 and 172 days to hatch, while a remaining egg took 208 days at a slightly lower temperature. Barnett attributed the slight difference in temperature to be the major factor in the incubation period. The Lace Goanna eggs were not maintained at a constant temperature, but as they were incubated indoors on top of heaters, it is presumed that the eggs were kept warmer than the outdoor temperature. This lack of temperature control is possibly

responsible for the (presumably) long incubation period of these eggs. Visser (1981) states that "The data available in the literature regarding the incubation period for the eggs of monitor lizards is very unclear; reports of duration range from 110 days to ten months."

As Barnett (1979) hypothesised, young hatching in the winter would probably not survive, while the spring months would be much more suitable. As the Lace Goanna eggs were laid in summer, it is assumed that they began to develop immediately while the temperature fluctuated between 28°and 34°C until about April, when the temperature dropped several degrees. Could it be possible that development of the eggs was suspended or at least slowed, while incubation temperatures were in the low 20°s for most of the time, and that development resumed in Spring? This would give an "active" incubation period of about six months. This strategy is advantageous if the species deposits more than one clutch during a season. A late clutch can overwinter and hatch in the following spring. An incubation period of between one and two years has been recorded for the Broad Shelled Tortoise (Chelodina expansa). (Cann 1978, p53).

Acknowledgements

I would like to thank the owner/manager of Maitland Nature Wonderland, Mr W. Hackney, for allowing me to incubate the eggs.

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SOME NOTES ON SYMPATRY BETWEEN *Tiliqua occipitalis* and *Tiliqua multifasciata* in the Ayers Rock Region and their Associations with Aboriginal People of the Area.

By: Greg Fyfe,
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Shea and Peterson (1981) showed that *Tiliqua occipitalis* and *T. multifasciata* are sympatric in a number of areas in Western Australia and the southern parts of the Northern Territory. The Northern Territory overlap zone extends as far north as Hermannsburg, 125 Km west of Alice Springs. It is not known if the Hermannsburg population of *T. occipitalis* is continuous with populations further south in the Ayers Rock area. No hybrids between the two species are known from this extensive overlap zone.

The population of *T. occipitalis* in the Ayers Rock region covers an extensive area; personal observations being from Curtin Springs, 80 Km east of Ayers Rock, to Armstrong Creek, 85 Km north-west of Ayres Rock. Discussions with Aboriginal people from the area indicate that both *T. occipitalis* and *T. multifasciata* can be found from Mt Conner in the east (20 Km south of Curtin Springs), west to Docker River on the W.A. — N.T. border area. The eastward range of *T. occipitalis* is extended slightly by the observation of a road killed specimen 37 Km north-east of Mt Conner, (A. Bridges, pers. comm.).

Throughout this extensive east-west overlap zone, both *T. occipitalis* and *T. multifasciata* occupy similar habitats. There are small areas of mallee (*Eucalyptus spp*) shrubland in this area and *T. occipitalis* is not confined or closely associated with that particular habitat type. This is in contrast to the situation reported by Shea and Peterson (1981).

Both species occur together in the following habitats —:

(1) Sand plains with *Triodia spp* grasses and scattered shrubs.
(2) Inter-dune swales with shrubs, mulga or *Triodia* grass communities.
(3) Mulga shrublands with *Triodia* grasses as an under storey.
(4) Other less distinct habitats, such as around salt lakes and clay pans where vegetation types mix and are complex.

T. multifasciata can be found on sand dunes, where *T. occipitalis* is rarely seen. Only *T. occipitalis* is found in mulga (*Acacia aneura*) where no *Triodia* grasses are present. It is also found on the rocky foothills in the vicinity of both Ayers Rock and the Olgas group. On these rocky soils, the vegetation is usually a mixed *Acacia/Cassia* shrubland with patches of tussock grasses or *Triodia irritans*. *T. multifasciata* is not found in the rocky habitats.

The Aboriginal people associated with Ayers Rock (the Pitjantjatjara) have separate names for both species, indicating that the two species have occurred together in the area for a long period of time. *T. occipitalis* is called Mita and is an important totemic ancestor for the area, figuring prominantly in the "myths and legends" of the "dreamtime" for the Ayers Rock area (Roff and Naningu, 1982, pers. comm.). *T. multifasciata* is called Lungata and is also implicated in some Ayers Rock "dreamtime" stories (Roff and Naningu, 1982, pers. comm.). Both Mountford (1981) and Harney (1979) have related "dreamtime" stories from the Ayers Rock area. Their researches were performed over 20 years ago and their informants were not the "true custodians" of the stories, hence both men appear to have received and related composite stories. Thus Mountford combines both Mita and Lungata under the name Meta-lungata, while Harney speaks of Loongardi.

Both species were used as food by the Aboriginal people of the area. Ceremonies were carried out at increase centres ot make certain food animals more abundant; the increase centre for Mita *(T. occipitalis)* is on the south-west side of Ayers Rock (Mountford, 1981).

Acknowledgements:

I would like to thank Derek Roff and Toby Naningu for their assistance with the Aboriginal folklore relating to these two lizard species. D. Roff, M.Gillam and M. Chuk read the manuscript and provided relevant critisisms.

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FIRST RECORD OF CAPTIVE PROPAGATION OF THE LACE MONITOR, *VARANUS VARIUS* (SAURIA: VARANIDAE)

J. Bredl, Bredl's Reptile Park and Zoo, Renmark, S. Aust.
T.D. Schwaner, South Australian Museum, North Terrace, Adelaide, S. Aust.

The Lace Monitor, *Varanus varius,* is the second largest species of goanna in Australia (Cogger, 1983; Houston, 1978). Although widely distributed in eastern Australia, the range of this semiarboreal lizard is restricted in South Australia to the upper reaches of the River Murray and the more forested areas of the southern Flinders Ranges. Little is known about the size or structure of lace monitor populations in South Australia, and, due to its restricted range, the species may well be a candidate for the State's rare or threatened list. All species of goannas are protected under the South Australian Wildlife Protection Act, and it is the policy of the South Australian National Parks and Wildlife Service that specimens may be taken from the wild only by strict scientific permits (A.C. Robinson, pers. comm.).

Captive breeding of lace monitors may be one way of maintaining the species provided that suitable habitat exists where the lizard may have once been abundant (e.g. see Houston, 1978, p.57), and where suitable methods of husbandry are developed.

The purpose of this brief note is to report the first successful breeding of the lace monitor in captivity and the hatching of a clutch of eggs.

Seven *V. varius,* four males and three females, were maintained in a large natural enclosure at the Bredl Reptile Park and Zoo, Renmark, South Australia. One adult male and female pair had been at the park for 10 years. The pair had mated each year since 1979, but eggs could not be recovered from the enclosure before being eaten by the other lizards.

At midday on 26.X.1982, after removing one of the two largest males from the enclosure, mating was observed between the remaining large male and one of the females. Mating between the same pair was observed again on 6.XI.1982.

On 8.XII.1982, the mated female, heavily gravid, was removed from the enclosure and placed in a large indoor terrarium. She laid seven eggs on the morning of 11.XII, 1982.

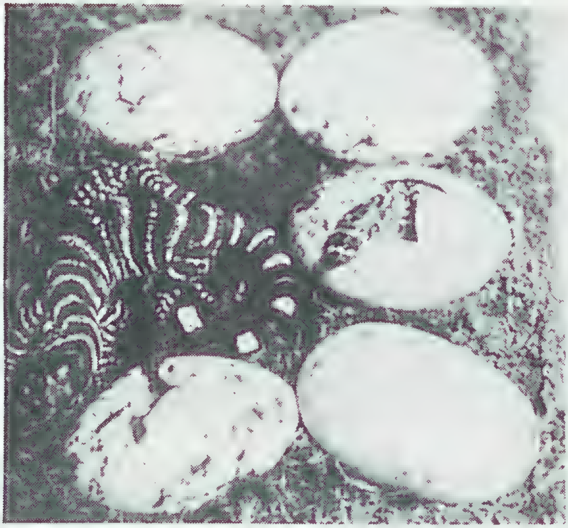

Figure 1. Plastic container used as an incubation chamber for eggs of *Varanus varius.*

Two of the eggs were small and deformed. The remaining eggs were of more normal size, 40x70mm, in length, weighing about 65g each.

The five eggs were incubated in plastic containers with damp peat moss at 30-32 deg. C (Fig. 1). Eggs were inspected once a week and water was sprayed over them to prevent drying. Relative humidity was estimated to be about 85%.

The first egg hatched on 13.V.1983, about five months after parturition. The remaining eggs hatched the following day (Fig. 2). Four of the five eggs produced heathy young but a fifth neonate died before leaving the egg. Body sizes and weights of neonates are presented in Table 1.

Table 1. Snout to vent lengths, tail lengths and weights of hatchlings *Varanus varius* bred in captivity.

No.	*SVL (mm)*	*TL (mm)*	*WT (g)*
1	*120*	*190*	*36*
2	*120*	*186*	*34*
3	*118*	*185*	*34*
4	*117*	*185*	*32*

Figure 2. Hatchlings of *Varanus varius.*

One lizard readily accepted newborn mice seven days after hatching. All surviving lizards were feeding two days later.

Breeding lace monitors in captivity appears to require large natural enclosures, removal of competing males, and careful observations to detect gravid females. The latter must be removed from the enclosure when visibly gravid. After parturition, eggs require the usual care of incubation with humid (and sterile, if possible) conditions.

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BOOK REVIEW

T.Phelps, "POISONOUS SNAKES". Blandford Press, 237pp., 16 colour plates. $12.95

The title of this book immediately evokes the story of the famous American herpetologist presented with a small live snake by a student who asked "Is this snake poisonous?" The herpetologist replied "I don't know", promptly bit the snake in half and swallowed it, and told the student to ask him again in a few hours. The moral of this story, told and retold in introductory University courses in herpetology, is that "poisonous" means that something causes you pain after you eat it, whereas things that hurt you by stinging or biting are more properly termed "venomous". Hence, I was biassed against Tony Phelps' book even before I started reading it. I have to admit that most of my fears were groundless: it is quite entertaining and pretty good value for money.

Don't buy it if your aim is to find out about Australian species. Mr Phelps works at the Poole Serpentarium in England, and his experience is primarily with the large venomous "exotics" that are the backbone of the zoo trade. He has a lot to say about the best ways to handle mambas, boomslangs, pitvipers, and the like, and has considerable field experience with English vipers. Most of his information on habits of other species in the field clearly comes from books on the topic. This is not a terrible failing in itself, as he has generally picked the right books. For example, virtually all that he has to say about the Australian thanatophidia is paraphrased from Hal Cogger's bible, undoubtedly the best available reference. The only non-Coggerian statement I could find was a reference to the taipan's supposed aggressiveness, and predilection to unprovoked attacks (p.77): I doubt that he would find many Australian herpetologists in agreement. His lack of first-hand experience of the Australian elapids is probably due to the scarcity of these animals in the international zoo trade.

Unfortunately, reliance upon other books for information falls down when no other books are available. Hence, Phelps' "worldwide" list omits New Guinea elapids (e.g. *Micropechis*), or puts them in the wrong genera (*Aspidomorphus* goes to *Cacophis*). Surprisingly, he has retained a very outdated concept of the Laticaudinae, embracing many hydrophiids as well as the true laticaudids. His list of venom toxicities ignores the CSL work in Melbourne, and I gained the impression that much of his information was gleaned from books rather than the primary research journals. Hence, it is a little out-of -date in some cases. One particularly puzzling omission is first-aid for snakebite: medical treatment is discussed in an Appendix, but nothing is said of the pressure-bandage technique that has revolutionized snakebite treatment in recent years.

Reptile-keepers will be interested in Phelps' opinions on husbandry, although perhaps disagree with his opposition to keeping venomous snakes in private homes. Surprisingly, nothing is said about drugs for treating diseases and injuries in captive specimens. Despite these objections, however, the book is a very readable blend of the popular and the scientific.

I suspect that most enthusiasts will enjoy the book, and in the process will learn a great deal about the venomous snakes of the world.

Richard Shine, Zoology A08, University of Sydney
28th September 1984

CONCERNING REPRODUCTION IN *MENETIA GREYII* IN CAPTIVITY.

I would be most grateful to anyone who has successfully incubated *Menetia greyii* eggs at constant temperatures if they could send me their data on the incubation period and temperature (including range) to:

Brian Bush, P.O. Box 192
Esperance, W.A. 6450

A NEW SOUTH WALES RECORD FOR THE FRECKLED TREE MONITOR *VARANUS TRISTIS ORIENTALIS*

Mark Fitzgerald, P.O. Box 237, Mullumbimby, NSW 2482

Varanus tristis is a widely distributed monitor in northern and inland parts of Australia. It is usually arboreal, sometimes saxicoline and I have seen *V.t. tristis* in Triodia sand-plain in the Northern Territory. This species is represented in north-western New South Wales by the Black-headed Monitor *Varanus tristis tristis* and a new record for the Freckled Tree Monitor *Varanus tristis orientalis* is presented.

In January, 1982 a visit was made to the Atholwood district of north-eastern New South Wales near the Queensland border town of Texas. At an isolated rock outcropping two *V.t. orientalis* were seen. The outcrop is one of two which rise slightly above open woodland of box gum, cypress pine, (Callitris) and wattle. Some areas have been ringbarked and open grassy pasture results. At the base of the rocks increased water catchment has resulted in greater vegetative growth, including large Ficus trees. The first *V.t. orientalis* was seen moving on a dead hollow gum, among cypress pine at the edge of the outcrop. A second specimen was seen basking on a dead hollow fallen gum away from the rocks, near a dry water-course. Two other specimens are known from this site, one from a hollow tree limb in the outcrop, the other from among rocks.

In appearance these lizards are typical of *orientalis* from the eastern parts of the range. Pale ocelli with darker centres are arranged in transverse rows across the dorsum. Some reddish colour appears between the ocelli especially toward the forelimbs. Ocelli continue to the neck, becoming simple pale circles toward the head and finishing around a line from ear to ear at the base of the head. Thanks are due to Steven Phillips for assistance in the field.

BIRTH OF *NOTECHIS CORONATUS* IN CAPTIVITY

John McGovern, 75 Blue Bush Rd, Kambalda West, WA 6444.

On the 6th January, 1983 I cautht a 420mm long specimen of *Notechis coronatus*. This was at Happy Hollow, approx 25km from Esperance (33°52' 121°53'). I found this snake at about 6.00pm under a partly buried log.

The snake was housed in a 75cm by 29cm by 35cm vivarium. The setting consisted of a hard sandstone rock, a long length of rough bark with a substrate of sand.

On the 18th January, 1983 I checked the *N. coronatus* **at about 12.40pm. The snake was not out, as had been its usual habit. I lifted the sandstone rock and found her lying there surrounded by three perfect replicas. I took a closer look at the soil under the rock and discovered the egg sacs. The estimated time of birth was 12.00pm as the soil under the rock was still damp.**

The juvenile snakes were approx 80mm in length and quite docile. In the first three weeks they all sloughed, after which I started to feed them.

One incident happened when I had just fed the mother snake. A juvenile commenced swallowing the tail of a skink which the female was swallowing. To solve this I had to bisect the skink to save the juvenile from possibly being a part of the females meal.

Scale Counts-Juvenile Notechis coronatus

1. Ventrals 140, Subcaudals 56 single, Midbody scales 15, Anal single.
2. Ventrals 129, Subcaudals 57 single, Midbody scales 15, Anal single.
3. Ventrals 128, Subcaudals 67 single, Midbody scales 15, Anal single.

NOCTURNAL ROAD BASKING BY GRAVID FEMALE *CACOPHIS SQUAMULOSUS* AND *CRYPTOPHIS NIGRESCENS* (SERPENTES: ELAPIDAE).

G.A. Webb, Forestry Commission of N.S.W., Wood Technology and Forest Research Division, P.O. Box 100, BEECROFT. N.S.W. 2119

W.S. Chapman, Forestry Commission of N.S.W., Taree Research Centre, P.O. Box 21, TAREE. N.S.W. 2430

On 30 December 1981 (2100-2230 hrs) seven gravid female *Cacophis squamulosus* (Gunther) and two gravid female *Cryptophis nigrescens* (Gunther) were recorded along a six kilometre stretch of gravel road through warm temperate/subtropical rainforest and wet sclerophyll forest in Mount Boss State forest (New South Wales). No males of either species were recorded.

Gestation was well advanced in all individuals since eggs or embryos were visible along the ventral surface. Three specimens of *C. squamulosus* and both *C. nigrescens* were retained for dissection. The stomachs of all except one *C. squamulosus* were empty. It contained the partially digested remains of a small skink. 4, 5 and 10 leathery shelled eggs were found in the oviducts of the three C. squamulosus respectively. The two *C. nigrescens* contained 4 and 5 well developed embryos. An additional *C. squamulosus* was retained in captivity for a short time before release. Five eggs were laid in mid January, 1982 of which two subsequently hatched in early March. The remaining three eggs suffered from fungal attack. Clutch sizes and time of oviposition and hatching were consistent with published data (Shine, 1980, McPhee, 1979, Gow, 1976).

Nocturnal snakes are commonly found basking on roads in the early evening during the warmer months drawing up stored heat from the road, however we know of no other instance where so many female snakes have been found in the absence of males. Clearly these gravid females are utilising the warm road to incubate the eggs or embryos. Ambient temperature (20°C, 2300 hours) was probably suficient for activity in males, conceivably foraging for food in the forest.

The absence of food in all but one of the stomachs examined agrees with Shine (1981) who suggests that most snakes cease feeding over the gestation period, directing energy reserves into costly incubation. The specimen of *C. squamulosus* maintained in captivity commenced feeding on Lampropholis guichenoti soon after laying the eggs.

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OBSERVATIONS ON THE MATING OF THE BARDICK, *Notechis curtas,* IN CAPTIVITY

P. Orange, 34 Saltbush Road, Kambalda West, W.A. 6444

Introduction

Two specimens of *Notechis curtas,* came into my care on 19th March, 1983. At that time the female measured 315mm, total length, and the male 300mm total length. They were housed together in an all glass vivarium.

Observations

On 2nd April, 1983 the female began sloughing at approx. 1830 hrs, and by 1900 hrs had completely rid herself of the slough.

After sloughing the female lay still. The male, while moving around the vivarium, happened to come upon the female. He immediately became 'interested' in her; moving his head over the posterior half of her body, and rapidly flickering his tongue over her. He proceeded to do this for the next hour, occasionally breaking off and moving away, but always remaining within the immediate vicinity. At approx. 2010 hrs, the male began to rub his chin and snout along the female's body. At this the female appeared to become excited, twitching and flicking her tail. The male then began to move up the female's body, crawling gradually on top of her; beginning at the tail and working his way up to her head. The male stopped when his head lay just behind the female's head, on the dorsal surface of her neck. He then forced his tail beneath the female's tail, so that the ventral surfaces were touching. The male then I believe inserted one of his hemipenes; although I did not actually see this occur. Almost immediately he began to 'vibrate' his tail against the female's tail.

They remained together, with the male occasionally 'vibrating' his tail against the female's until 2220 hrs. Since then they have been observed mating on three further occasions.

Comments

The male had taken little interest in the female until she sloughed. He then immediately became interested in her, and she became receptive to him.

Acknowledgements

I would like to extend my thanks to B. Bush and B. Maryan for their assistance.

OBSERVATIONS ON THE LACE MONITOR *Varanus varius*

Theo Tasoulis, 33 Frederick St, Dudley 2290

At 1200 hours on the 2nd January, 1983 on Black Knob Trail in the Chichester State Forest I observed a pair of *Varanus varius* mating. The weather was overcast and warm. When first noticed the female (approx. 1.1 metres in total length) was lying flat on the road while the male (approx. 1.4 metres in total length) was about 25 metres further down the track. After about 10 minutes he began to move towards the female who was concealed (to him) behind a rise in the road. I believe he located her by scent. The area near the female had a fairly strong odour which was noticable to both a friend and myself. When the male was within 2 metres of the female he turned side on to her and with all 4 legs stiffened raised his whole body high off the ground. He approached the female from behind and grabbed her with claws and jaws, biting her neck savagely. The female ran about 3 metres with the male still hanging on, he then let go with his jaws and began rubbing her neck violently with his snout. When I approached to within 5 metres to take the photos the male raised his head and gave a prolonged hiss. Not wishing to disturb the pair I backed away. While I was taking photos of the pair another large monitor appeared about 50 metres down the track — this could be further evidence that the female attracts males by scent. The pair copulated for about 2 minutes then separated.

NOTES ON MITES OF THE FAMILY UROPODIDAE USING A SKINK AS A MEANS OF DISPERSAL

R.P.V. Rowlands, 6 Tobruk Crescent, Milford, Auckland 9. N.Z.

In November 1981 a copper skink (*Cyclodina aenea*) was found in the Milford, Auckland area, with large numbers of reddish-brown mites attached around the limbs. (see fig. 1). The mites appeared to be attached fairly loosely, and when removed from the lizard by careful scraping with a knife blade, they moved about quite freely.

Specimens of the mites were forwarded to the Entomology Division, Department of Scientific and Industrial Research, and were there identified as deutonymphs of a species of the family Uropodidae; further identification is not possible at present. They are not parasitic, but were using the skink as a means of dispersal, each mite attaching itself to the skink by means of a stalk secreted by special anal glands. Usually insects (especially beetles) are utilised in this way, and the use of lizards for this purpose has apparently not been recorded in New Zealand to date. (G.W. Ramsay, pers. comm.).

Acknowledgements

Thanks are due to my mother, who found the skink while gardening, and Dr G.W. Ramsay of the Department of Scientific and Industrial Research for identifying the mites and commenting on their means of dispersal.

HERPETOFAUNA

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OBSERVATIONS ON THE NESTING AND NATURAL INCUBATION OF THE LONG-NECKED TORTOISE *Chelodina expansa* IN SOUTH-EAST QUEENSLAND

by

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Introduction

The broad-shelled river tortoise, *Chelodina expansa,* inhabits the permanent streams and waterholes of the Murray/Darling River System and of coastal Queensland (Cogger, 1975). It is probably abundant throughout much of its range, but owing to its secretive habits, specimens are difficult to obtain in sufficient numbers for intensive ecological studies. Nevertheless, several aspects of the natural history of *Chelodina expansa* have been described (Goode, 1966; Goode and Russell, 1968; Legler, 1978; Chessman, 1978, 1983; Bustard, 1980; Woodall, 1984).

Knowledge of the reproduction of the species is due largely to the work of Goode and Russell (1968). They found that *Chelodina expansa,* from the Murray River Valley of northern Victoria, nests in autumn (March to May) and occasionally in early spring (September). Compared with two other species in the same region, *C. expansa* had by far the most protracted incubation period, both in the field and when the eggs were incubated at 30°C. Mean incubation period under natural conditions was 75 days for the eggs of *Emydura macquarii* and 138 days for those of *Chelodina longicollis*, whereas the eggs of *C. expansa* normally incubated longer than 324 days. Goode and Russell (1968) explained the exceptionally long incubation of *C. expansa* in terms of the effects of overwintering on the early embryo, and in terms of anatomical features, peculiar to the species, that retard yolk ingestion of advanced embryos.

This article contains details of some scattered observations on the nesting, eggs, and incubation period of *Chelodina expansa* in south-east Queensland — observations that were incidental to more intensive studies of short-necked tortoises of the region (Georges, 1982). Included also is speculation, in addition to that of Goode and Russell (1968), on the reasons for the exceptionally long incubation period of the species.

Results

Nesting:

Table I is a summary of nesting times, locations and clutch sizes, for *Chelodina expansa*. Nesting occurs in autumn and winter, but may also occur in spring since the ovaries

of one specimen (8) contained corpora lutea in November (corpora lutea of freshwater tortoises are known to degenerate rapidly after egg laying; see Georges, 1983). This nesting period is exceptionally long and probably reflects the ability of the tortoises to lay more than one clutch of eggs per year, as is usual for all species of tortoise so far studied in Queensland (Legler and Cann, 1980; Georges, 1983). The winter nesting of *Chelodina expansa* sets the species apart from other species of Australian tortoise which, in the temperate zones, typically nest in the spring and early summer (Parmenter, 1976; Chessman, 1978; Burbidge, 1981; Georges, 1983).

In all cases, nesting occurred during or shortly after moderate to heavy rain. Nesting also occurred during the daylight hours (with the possible exception of observation 7). Perhaps temperatures at night in autumn and winter are too low to permit nesting activity, though the finding may equally indicate that nesting tortoises are unlikely to be found at night. Sites chosen for nesting varied in distance from water (9 to 750m), in exposure, and in groundcover. However, the nests were usually at the top of a ridge (nests 2 and 5) or where the slope of the land levelled off for a distance before continuing to climb (nests 4 and 6).

Eggs:

Chelodina expansa lays white, hard-shelled (calcareous), ellipsoid eggs (see Woodall, 1984). A total of 46 eggs from four females yielded the following statistics:

Egg Length 33.5 - 41.9mm (X = 38.3 +/- 0.3mm)
Egg Width 22.2 - 30.1mm (X = 26.8 +/-0.4mm)
Egg Weight 11.5 - 20.4g (X = 16.5 +/-0.4g)

Mean egg weights differed significantly among nests (ANOVA, F = 161.0, p (0.001), and eggs from a single nest differed by as much as 7.5mm in length and 3.4g in weight.

Incubation:

On 18 April 1981, Miss Fay Southcombe of Brookfield, Brisbane, found a Chelodina expansa nesting at her home. The nest was opened twelve days later and the eggs were counted and measured. They were replaced in the nest which was then protected from predators by wire mesh arranged so as not to shelter the nest from rain or sunshine. Fay diligently checked the nest morning and night until three hatchlings emerged on 16 March 1982, some 331 days after the eggs were laid. The nest was uncovered to reveal that the remainder of the eggs had died at various stages of development, from unidentified causes. This period of 331 days confirms the exceptionally long incubation, with overwintering of eggs, reported for the species by Goode and Russell (1968). The hatchlings weighed between 10.0g and 10.2g — large offspring when compared to those of other chelid tortoises. In comparison, Krefft's River Tortoise, *Emydura krefftii*, produces hatchlings that can weigh as little as 4.6g on average (Georges, 1983).

Discussion

The results together with those of Goode and Russell (1968), show that the reproductive pattern of *Chelodina expansa* is a curious one, and one that warrants further investigation. The species, unlike all other tortoises in temperate Australia, nests in autumn and winter. It has an exceptionally long incubation period with the hatchlings emerging in the autumn only to face the cold weather to follow. Little development of eggs can be expected in winter, and overwintering of eggs no doubt contributes substantially to the incubation period of the species. However, other factors must also be involved because the eggs of *Chelodina expansa* laid in autumn still hatch some months after those of *Emydura macquarii* and *Chelodina longicollis* laid in the following spring (Goode, 1967:38). Goode and Russell (1968) found that the orientation of the embryos of the long-necked *Chelodina* species differed from that of the short-necked *Emydura macquarii*. The embryo of *E. macquarii* is oriented with the long axis of the carapace parallel to the long axis of the eggshell, so that the body of the embryo is constricted only at the lateral and posterior marginal shields. In contrast, embryos of the *Chelodina* species lie with the body at right angles to the long axis of the shell, and this arrangement according to Goode and Russell, severely restricts their visceral capacity. "Presumably, this restricted visceral capacity results in a much slower yolk-absorption rate, because it takes the embryo of

C. longicollis about 35 days to ingest a quantity of yolk similar to that which an *E. macquarii* embryo can ingest in five days" (pge 758). Goode and Russell conclude that this slower rate of yolk ingestion is the major factor contributing the difference in incubation period between *Chelodina longicollis* and *Emudura macquarii*. This anatomical argument, together with the effects of overwintering of eggs, is also used by Goode and Russell to explain the exceptionally long incubation period of *C. expansa*. However, I suggest that variation in egg size must be considered when explaining variation in incubation rates. Table II is a summary of knowledge of incubation periods and egg sizes of chelid turtles. Perusal of the data in Table II reveals that both egg size and incubation period vary considerably. In fact, egg weight and incubation period at 30°C were highly correlated (r = 0.96, n = 8, p (0.01), which gives strong support to the notion that larger eggs, and the large ensuing offspring, wil need longer to develop. *C. expansa, Elseya dentata* and *phrynops gibbus nave the largest eggs and the longest incubation periods (Table II).*

The winter nesting of *C. expansa* is more in keeping with the tropical strategy of coping with the seasonal cycles of wet and dry rather than coping with the temperate cycles of hot and cold, and this requires some explanation. Legler (1978) considers *C. expansa* to be closely related to *C. rugosa* of northern Australia. It may well be that *C. expansa* originated in tropical Australia and that it is a recent arrival in the temperate zones, having spread rapidly through the Murray-Darling system, to which its distribution is largely confined (Cogger, 1975). At the same time, the species may have retained many of the features of a tropical reproductive strategy.

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Table I. Details of observations on the nesting of the Broad-shelled Tortoise, *Chelodina expansa,* in south-east Queensland.

Ref.	Date	Time	Carapace length mm	Clutch size	Location	Notes
CE1*	—		330	14	Kedron Brook, Brisbane.	—
CE2	20-MAR-79	—	—	10	St Lucia, Brisbane.	Nesting female,** successful attempt.
CE3	28-MAR-81	1530	325	—	St Lucia, Brisbane.	Nesting female returning to water. Rear of carapace and hind legs covered in clay.
CE4	4-APR-81	1730	—	12	Brookfield, Brisbane.	Nesting female,† successful attempt.
CE5	24-JUN-79	1230	287	17	Hidden Lake, Fraser Island.	Nesting female, successful attempt.
CE6	30-JUN-78	1500	—	—	Jennings Lake, Fraser Island.	Nesting female, abortive attempt (disturbed).
CE7	6-AUG-78	before	—	9	Lake Coomboo, Fraser Is.	Freshly constructed nest.
CE8††	16-NOV-79	—	294	—	Lockyer Creek, Brisbane Valley	Corpora lutea on ovary.

* Queensland Museum specimen J35344, X-rayed.
** Sighted and later reported to me by staff of the Queensland University Pottery.
† Sighted and later reported to me by Fay Southcombe.
†† Captured by Ian Johnston.

Table II. Egg sizes and incubation periods for various chelid turtles.

SPECIES	Egg Dimensions Length	Width	Weight	Incubation Period (days • 30°C)	SOURCE
Chelodina expansa	38.3	26.8	16.5	135	Goode & Russell (1968) present study
Chelodina longicollis	30.8	20.4	7.5	67	Legler & Cann (1980)
Chelus fimbricatus	37.5	34.3	—	208*	Goeldi (1898)† Hausmann (1968)
Elseya dentata	48.6	27.7	15.7	160	Legler & Cann (1980)
Elseya latisternum	35.9	24.0	12.1	60.5	Legler & Cann (1980)
Emydura kreffti	36.5	21.1	9.8	47.3	Legler & Cann (1980)
Emydura macquarii	33.0	23.0	10.5††	44.1	Goode & Russell (1968)
Phrynops gibbus	43.7	30.6	25.2	152**	Medem (1973)
Rheodytes leukops	29.7	21.2	7.5	46.7	Legler & Cann (1980)

* 28.3-29.5°C
** 28-32°C
† as cited by Ewert (1979)
†† estimated from linear dimensions

AN INVENTORY OF THE REPTILES OF DANGGALI CONSERVATION PARK

by T.P. Morley & P.T. Morley

Summary

A survey of the reptiles of Danggali Conservation Park was conducted monthly from October 1976 to October 1977 and at various times thereafter to the present. Forty seven species representing 28 genera and 7 families of reptiles were recorded from field observations, a search of specimens previously deposited in the South Australian Museum, and from the literature.

Introduction

Danggali Conservation Park was established in 1976, from the aquisition and dedication of 253,000 hectares formally comprising Canopus, Hypurna, Morganvale and Postmark properties. The park is located in the northern half of the Murray Basin 80km north of Renmark, South Australia. The border between South Australia and New South Wales forms the eastern boundary of the park.

Previously only general collections were made in the area. No comprehensive surveys of reptiles have been reported for the park. In this paper we provide a list of reptiles observed in a large section of the park with notes on their microhabitats, distributions and behaviour.

Materials and Methods

Surveys were conducted in monthly visits during 1976-77, and at various times to the present. Nineteen field trips, two to three days in duration, comprised a total of 46 survey days in the park.

Sampling was confined to the southeastern corner of the park near Canopus and Hypurna homesteads (Fig. 1). Most of the area consists of rolling dunes covered with mallee (*Eucalyptus* spp.), spinifex (*Triodia* sp.) and chenopods (*Atriplex* spp., *Bassia* spp. and *Kochia* spp.), with small pockets of black oak (**Casuarina cristata**).

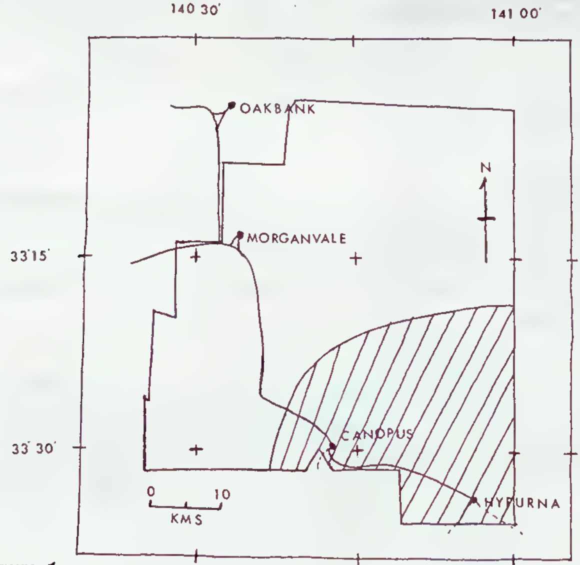

Figure 1
Danggali Conservation Park showing area surveyed (cross-hatch).

Reptiles were collected in pit falls with drift fences and by intensive hand collecting, both by day and night. Some specimens were collected by resident park rangers.

A search of the literature and records at the South Australian Museum resulted in the addition of three species to our lists.

Nomenclature follows Cogger (1983). All registration numbers are for voucher specimens in the South Australian Museum.

Results

Family Scincidae

Cryptoblepharus carnabyi. Common around trees and fence posts.

Ctenotus atlas. R17094. Frequently found around spinifex.

C. brachyonyx. R15896, R15989, R16667A-B. This species is uncommon; R15896 is the first specimen collected north of the River Murray (Houston, in litt. 3/3/1977).

C. brooksi iridis. This species has never been found in the park; however, the Museum has a specimen from nearby Calperum Station.

C. reguis. R19936. Common throughout the study area.

C. robustus. We have never found this species; but the Museum has a specimen (R17107) collected in the park.

C. schomburgkii. R22220. Common throughout the study area.

Egernia inornata. Fig. 2. This species is common in complex burrow systems around spinifex.

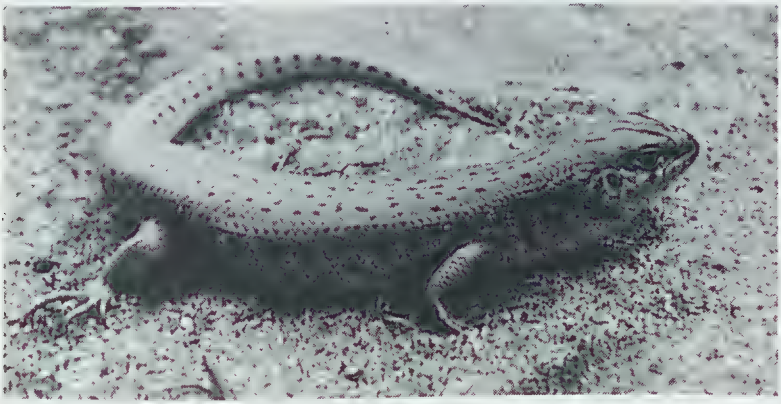

Fig. 2 *Egernia inornata*

E. striolata. This species is common on fallen trees and fence posts. It also appears to live in colonies.

Eremiascincus richardsoni. R16059. Quite common in the study area and is often found while spotlighting.

Lerista muelleri. R18845. Frequently found under dead wood.

L. punctatovittata. Fig. 3. R16668, R16669, R18847. Common under all forms of cover and is also frequently caught in pit falls.

Menetia greyii. Common in undergrowth.

Morethia boulengeri. Common in mallee.

M. obscura. Common throughout the study area.

Tiliqua branchialia. R15988, R16666A-B. The specimens listed are the only ones known from the area.

T. occipitalis. This species is not as common as expected. We have only found three specimens and none is represented in the South Australian Museum.

Trachydosaurus rugosus. Common in all habitats.

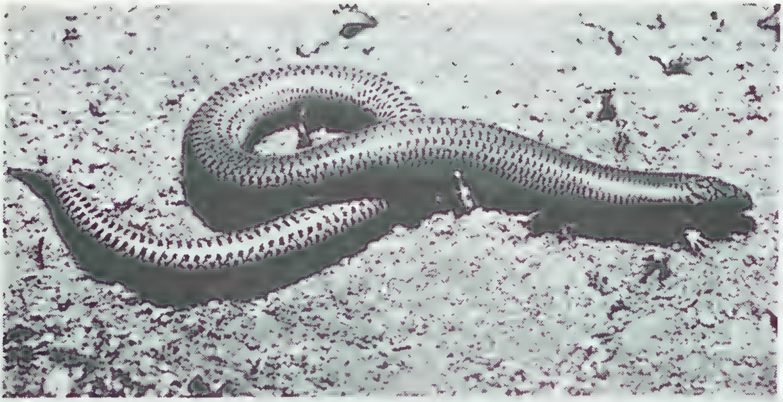

Fig. 3 *Lerista punctatovittata*

Fig. 4 *Nephrurus levis*

Family Pygopodidae

Delma australis. R16060. This is the only specimen we have found; the South Australian Museum has one further specimen (R17106).

D. nasuta. R17659A-B. This species seems to be fairly common and the South Australian Museum has several specimens. During the survey we found difficulty in separating this species from the closely related *D. inornata*. For the purpose of this survey all Danggali specimens are referred to as *D. nasuta*.

Lialis purtonis. This species is quite common, and variable in colour pattern.

Pygopus lepidopodus. R17022. We have only found one specimen; subsequently the Museum has obtained one further specimen (R17123).

Family Geckonidae

Diplodactylus elderi. R16055. Common in spinifex tussocks.

D. intermedius. Fairly common while spotlighting.

D. vittatus. Only one specimen found; unfortunately it was not collected.

D. williamsi. Commonly encountered while spotlighting. This species was not known from South Australia until B. Miller collected specimens from Danggali (Schwaner & Miller, in prep.).

Gehyra variegata. Common in a wide range of habitats.
Heteronotia binoei. Common throughout the study area.
Lucasium damaeum. R17877. This is the most commonly encountered lizard while spotlighting.
Nephrurus levis. Fig. 4. R17095. Several specimens have been found, all while spotlighting.
Rhynchoedura ornata. Common while spotlighting.

Family Agamidae
Amphibolurus fordi. R17880. This species is common anywhere spinifex is found, and is often caught in pit falls. One specimen was found in a burrow belonging to an *Egernia inornata*, and another specimen (R17880) collected on 26/1/80 contained three eggs.
A. nobbi. This species is quite common in the study area but is seldom seen. It is occasionally found while spotlighting on hot summer nights (Morley 1982).
A. pictus. R21694. This species is widely distributed in the study area, but is not common.
A. vitticeps. The largest Dragon in the park; common, particularly in the bluebush and on fence posts.
Tympanocryptis lineata. This little Dragon is very uncommon in the study area. We have never found one. A juvenile was found by the rangers on Hypurna airstrip and the Museum has a further specimen (R17129) also found at Hypurna.

Family Varanidae
Varanus gouldii. This is the only Goanna we observed in the study area. Although other evidence suggests it is quite common, we have seen few individuals.

Family Typhlopidae
Ramphotyphlops australis. R17096. Common; frequently found crossing the road while spotlighting.
R. bituberculatus. R17097, R17098A-B. Also frequently found while spotlighting.

Family Elapidae
Demansia psammophis. This would be the most commonly encountered snake.
Echiopsis curta. R16062. This specimen was dug up with a bulldozer, and is the only one we found.
Pseudechis australis. Widely spread throughout the study area, but seldom encountered.
Pseudonaja modesta. R16063, R17021. Common; frequently found in the early morning.
P. nuchalis. R17876, R18843, R19853. Widespread but not as common as the previous species.
Simoselaps australis. Only two specimens seen.
Unechis nigriceps. R16061. Since this specimen the Museum has acquired two more (R17116, R23919).
Vermicella annulata. Two specimens have been found by Paul Jennings, one (R23866) was collected while bulldozing.

Discussion

Prior to our first visit, in October 1976, Danggali had three good years of above average rainfall. Dams were almost full and vegetation was lush and plentiful. Since that time rainfall has been below average, most dams have dried out, and there has been a drastic decline in vegetation. During this time there appeared to be a noticeable decline in the numbers of reptiles observed. This survey included only about a third of the total area of the park and excluded larger areas of black oak and mulga habitats which occupy the more northern areas of the park (P. Jennings, pers. comm.).

For these reasons this may not be a complete list of the reptiles in Danggali Conservation Park. A survey concentrated in more northern areas, possibly in another good season, could yield more species in this remote and little studied park.

Acknowledgements
We would like to thank all the Rangers who have assisted us while conducting field work in Danggali, Paul Jennings also advised us on several aspects of our survey. Dr A.C. Robinson kindly allowed us access to internal files on Danggali, and assisted in obtaining Scientific Collecting permits.

We are also thankful to Dr T.F. Houston, Ms Adrienne Edwards and Dr T.D. Schwaner for providing access to Museum records whilst in their care, and special thanks to Dr T.D. Schwaner for his assistance during preparation to the manuscript.

Julie Morley assisted in the field and the Bureau of Meteorology provided the rainfall data.

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THE LIZARD FAUNA OF CASTLE ROCK, COROMANDEL, NEW ZEALAND.

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Abstract

The geckos *Hoplodactylus maculatus* and *pacificus*, and the skinks *Cyclodina alani, C. whitakeri* and *Leiolopisma moco are recorded from Castle Rock.*

Introduction

Castle Rock (175°53' E, 36°52' S) is situated 5km off Hot Water Beach on the east coast of the Coromandel Peninsula, New Zealand. The nearest other islands are the Ohena group 15km north, the Mercury group 25km north, and the Aldermen group 20km south east. Castle Rock consists of a rhyolitic plug of less than one hectare rising to 60m asl., and is appropriately named as it is almost completely surrounded by vertical cliffs.

The top of the island is covered in coastal forest in which pohutukawa (*Meterosideros excelsa*) is the predominant species and forms a canopy at about 10m. Understorey species include karo (*Pittosporum crassifolium*), five finger (*Pseudopanax lessonii*), and mingimingi (*Coprosma propinqua*). The fern *Asplenium flaccidum haurakiadenis* and bush flax (*Astelia banksii*) form a thick ground cover. Taupata (*Coprosma repens*) occurs on the cliffs and ice plant (*Disphyma australe*) above the splash zone.

Nesting petrels are abundant on the top of the island and their burrows occur where ever there is sufficient soil for them to tunnel. Castle Rock appears to be unmodified by man and no introduced rodents occur there.

Visits to Castle Rock were made on January 2nd, 1980 and December 22nd, 1980, a total of nine hours being spent ashore, all during daylight.

Castle Rock

Annotated species list

Nomenclature follows Robb & Rowlands 1977 for geckos, Hardy 1977 for skinks, and Newman 1982 for common names.

Common gecko (*Hoplodactylus maculatus* (Gray 1945): These nocturnal geckos were extremely abundant all over the island and were found where ever there was suitable cover such as loose rock, rock crevices or even petrel burrows.

Pacific gecko (*Hoplodactylus pacificus* (Gray 1842)): This species was abundant and widespread, and was collected from sites similar to the common gecko. The pacific gecko on Castle Rock was characterised by an orange tinge to the dorsal surface but none

was seen with the mustard yellow markings described for other northern populations (Sharell 1966).

Moko skink (*Leiolopisma moco* (Dumeril & Bibron 1839)): Two adult moco skinks were recorded, one basking on a rock and the other in a petrel burrown.

Robust skink (Cyclodina alani (Robb 1970): These large (adults approximately 130mm snout — vent length, 260mm total length) nocturnal skinks were very common on Castle Rock. Adults were most frequently found in petrel burrows, often in the company of common and pacific geckos. Twice adult pairs of robust skinks were found in the same retreat. All the juveniles of this species that were found were under loose rocks or in rock crevices which they sometimes shared with common and pacific geckos, and *C. whitakeri*. Several very large lizard faeces, presumed to be from this species, were examined and found to contain only the chitonous remains of darkling beetles (*Mimopeus* spp.) and woodlice (*Isopoda*) which were the most conspicuous and abundant invertebrates on Castle Rock.

Forest Interior Castle Rock

Cyclodina whitakeri Hardy 1977: This nocturnal species was found where ever there was suitable cover such as loose rocks, rock crevices, sea bird burrow systems, — particularly those under bush flax and the fern *Asplenium flaccidum haurakiadenis*. Two were observed out in daylight at the entrance of bird burrows. In captivity they have been observed frequently out basking in filtered sunlight and this is perhaps what there two were doing. No C. whitakeri **were seen with original tails; this was probably due to the high numbers of** *C. whitakeri* and *C. alani* present on Castle Rock. Captive specimens have been observed to fight, and seem to be very territorial. Castle Rock specimens were heavily blotched with yellow and black along the sides of the body and the under-surface was frequently orange-pink.

Discussion

This is the first species list for lizards for Castle Rock. The presence of the common gecko, pacific gecko, and moko skink is not unexpected as Castle Rock lies within their known range and has suitable habitat. The occurence of the robust skink and *C. whitakeri*, however is surprising, as both these are very rare and have very restricted distributions.

The robust skink has been collected only from Moturoa Island, Moturoa group, Middle and Green Islands in the Mercury group and Castle Rock where its presence has been known since 1972 (A.H. Whitaker, pers.comm.; Hardy 1977; Robb 1980; Williams & Given 1981). Castle Rock is the most southerly record for this species.

Cyclodina whitakeri was previously known only from Middle Island in the Mercury group and Pukerua Bay on the Wellington coast (Hardy 1977; Hardy & Whitaker 1979) and at both localities it is uncommon. *C. whitakeri* was accorded a "vulnerable" rating in the New Zealand Red Data Book (Williams & Given 1981) so the discovery of the Castle Rock population, the most abundant one yet, considerably enhances its chances of survival. The only other known locality where robust skinks and C. whitakeri occur together is on Middle Island where their habitat is also occupied by marbled skinks (*Cyclodina oliveri*).

The extremely low number of moko skinks seen suggests the population is small, probably because of the restricted amount of suitable habitat available. This species because of its diurnal habit, requires non-forested habitat and is most abundant in grassland or flax (*Phormium tenax*)(Whitaker 1968; McCallum & Harker 1981). On Castle Rock such habitats are confined to a smal area on the northern end.

Other lizard species which could be expected to occur on Castle Rock are: Duvaucel's gecko (*Hoplodactylus duvauceli*), oviparous skink (*Leiolopisma suteri*), shore skink (*L. smithi*), marbled skink and copper skink (*Cyclodina aenea*) all of which are known from the Aldermen, Ohena and Mercury Island groups (Hardy 1977; Towns & Hayward 1973; Whitaker 1978; and A.H. Whitaker, pers. comm.). Towns 1972 recorded the ornate skink (*Cyclodina ornata = Sphenomorphus pseudornatus*) on Red Mercury Island so it is also a possibility. The habitat on Castle Rock is probably not damp enough for copper or ornate skinks, and marbled skinks may be absent because of competitive exclusion by robust skinks and *C. whitakeri*, as suggested by Hitchmough 1977. However, it is unclear why Duvaucel's gecko, oviparous and shore skinks are absent. Apparently suitable habitat is available and elsewhere they certainly thrive on similarly small islands. For the oviparous skinks, lack of nesting sites might be a limiting factor.

The observation that adult and juvenile robust skinks did not share the same retreat, and that *C. whitakeri* were not found with adult robust skinks, suggests that large robust skinks might prey on smaller nocturnal skinks.

Acknowledgements

I would very much like to thank Tony Whitaker for his constructive criticism and help in writing this manuscript.

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A SUPERNUMERARY LIMB IN THE SPOTTED GRASS FROG, *LIMNODYNASTES TASMANIENSIS*

G.A. Webb, Forestry Commission of N.S.W., P.O. Box 100, BEECROFT. N.S.W. 2119

On 3 February, 1980 an abberant specimen of the Spotted Grass Frog, *Limnodynastes tasmaniensis,* was caught in a pitfall trap in Bondi State Forest (37°09' S 149°09' E) near Bombala (New South Wales). The animal was trapped during routine sampling in open forest of the Manna Gum (*Eucalyptus viminalis*) — Narrow-leaved Peppermint (*Eucalyptus radiata*) type (sensu Baur, 1965). The site is located approximately 300 metres from a permanently running stream and associated bog.

A supernumerary limb (figure 1) is attached anterior to the pectoral girdle in the throat region. The limb is degenerate though it possesses elbow and wrist joints and rudimentary digits. Whether the limb was functional is unknown.

There have been few published records of supernumerary limbs in Australian frogs. Tyler (1976) provided a photograph of a tree frog (*Litoria sp.*) with an extra pair of arms on one side of the body. Tyler (1983) provided a photograph of a *Limnodynastes tasmaniensis* with an additional well formed limb apparently orginating from the anal region. Sadlier (pers. comm.) captured a specimen of *Limnodynastes peronii* with 3 additional but degenerate limbs.

Frogs, particularly in their early developmental stages, are sensitive to chemical pollutants (Birge, et al 1979, Johnson 1976, Tyler 1976 and 1983). It is during the larval phase of their life cycle that these pollutanto can invitiate abnormal growth resulting in physical abnormalities such as supernumerary limbs and digits, digit fusion and stunting and unusual skin pigmentation (Tyler 1983). The incidence of supernumerary limbs in adult anurans is no doubt considerably less than for other often less obvious abnormalities of digits and skin.

Anurans, being highly sensitive to chemical pollutants, are likely to be useful natural pollution monitors (Birge, et al 1979, Tyler 1983) providing, as Tyler (1983) suggests, natural levels of abnormalities can be ascertained. This he suggests is in the order of 0.5 to 1.2 percent.

Acknowledgements
Ross Sadlier generously provided unpublished data.

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MALE/MALE COMBAT IN THE WESTERN BANJO FROG, *LIMNODYNASTES DORSALIS* (GRAY)

By BRIAN BUSH, P.O. Box 192.
Esperance, 6450.

The following behaviour was observed at Coomalbidgup, Western Australia (33°45'S, 121°20'E) at 9.20pm on 23 May, 1982.

The male *L. dorsalis* were located 35cm apart on the edge of a shallow pond approx. 45cm diameter and to a depth of 25mm. Visual contact between them is believed to be zero due to the close formation of the grasses growing in and around the water. This suggests audible contact only during the initial stages of the observed behaviour.

Both frogs were calling, occasionally in unison but more often alternately, from the perimeter of the pool. At some indeterminable signal the pair simultaneously moved towards each other and also to the less vegetated central part of the pond. This not only gave them a clear area for the impending struggle but allowed me an unimpaired view of this.

Contact was made from the front, head to body: the head of one passing beside the head of the other, and a pushing match commenced. When one frog managed to cause his opponent to back-pedal it would raise a forelimb beneath the other's body and attempt, often with success, to throw him onto his back. After several moves back and forth, and an occasional flip onto the back experienced by both individuals, contact would break and the contestants return to the edge of the pool and recommence calling. Then, after two or three minutes, it was back to the 'arena' for further combat.

This behaviour, calling-combat-calling was repeated several times during a 25 minute period with honours being shared equally. The end came when both frogs moved away from the pond in different directions. The size and weight of the combatants appeared to be about equal, and neither gained any obvious advantage over the other during this encounter.

After the pair had moved off I searched the area for conspecific females with no success. Male/male combat may occur when two (or more?) sexually mature males meet. The lack of females in close proximity tends to suggest that the observed encounter was competition for a prime calling site. Under different circumstances, i.e. a strong healthy male v. a deformed or weak one, the result may have been the exclusion of the latter from the pond. That both males moved away from the site suggests they each expended sufficient energy to elicit withdrawal behaviour.

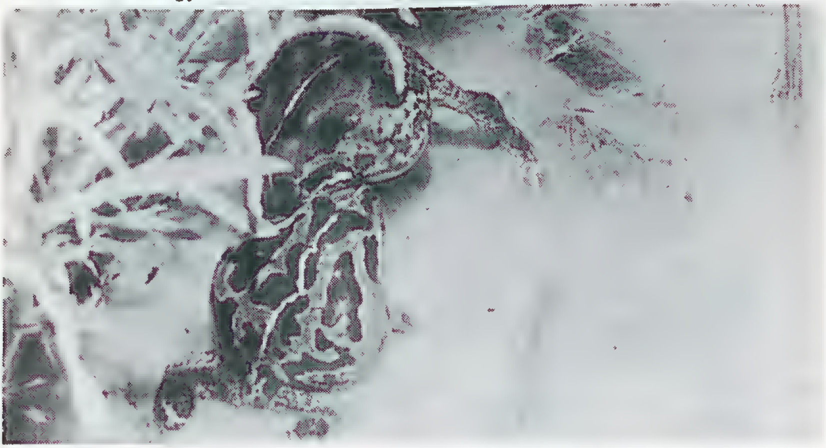

Figure 1: Male *Limnodynastes dorsalis* involved in combat.

BURROW CONSTRUCTION AND UTILISATION BY THE LIZARD. *CTENOTUS TAENIOLATUS.*

Janet A. Taylor, Zoology Department, University of New England, Armidale, N.S.W., 2351.

Introduction

The skink, *Ctenotus taeniolatus,* common in eastern Australia, occurs in habitats from coastal heathlands to dry sclerophyll forest and wetter montane forest (Cogger 1979, Jenkins and Bartell 1980). Within these habitats skinks usually seek refuge under rocks, or sometimes logs where they construct burrows which can theoretically provide protection from environmental extremes and predators, as well as ovipositional sites. The aim of the present study was to define the nature of the burrows of *C. taeniolatus,* to determine if they were used differently by lizards of different sizes and to determine if lizards modified burrows as a response to environmental extremes, temperature in particular.

Methods:

Lizards were collected in summer and winter, within 4 hours of dawn, from the New England Tablelands of NSW. Upon collection lizard body temperatures were taken (Comarck single channel recorder; (± 0.1.C) and burrow and maximum rock length, depth and width, were measured with string and compared against a graduated rule (± 0.5cm). Rock size was estimated as rock volume by multiplying rock length, depth and assuming the rock to be a rectangular prism. The presence of other animals under the rock was noted. Measurement (SV length, tail length and body weight) and sex were determined for captured lizards later in the laboratory. Sexes were categorised as either adult female, adult male or juvenile, so these categories were an estimate of size as well as sex.

Continuous burrow temperatures were recorded using a Mersteel Temperature Recorder (± 1 C), which had probes located in burrows under rocks 4 and 40 cm deep respectively. Soil moisture levels were determined by collecting a known weight of soil from around a lizard burrow and then drying it at 100°C until the weight stabilised. Moisture content was expressed as a percentage of dry wight. Throughout the paper Fa,b refers to the F ratio with a and b degrees of freedom, NS means not significant and SD is standard deviation.

Figure 1: Typical burrow of *Ctenotus taeniolatus.*

Results:

Fig. 1 depicts a typical burrow of *C. taeniolatus.* Rocks selected for burrow construction were independent of lizard sex ($F_{2,36}$ = 2.27, NS) and season, when adults only were compared ($F_{1,24}$ = 0.48, NS). In fact, rock sized used by *C. taeniolatus* were very variable and followed no discernible pattern. Mean rock size was 473.6 cm3 (SD = 4803.4).

Lizards always selected rocks with soil underneath as it was in this soil that burrows were constructed. Mean soil moisture content was 3.8% (SD = 9.3). Burrow structure, like rock size, was very variable and followed no discernible pattern. Mean (SD) burrow length, width and depth were 22.5 (19.2), 12.8 (16.4) and 2.3 (1.9) cm respectively and were not significantly different for males, females or juveniles $F_{2,37}$ = 0.83, $F_{2,38}$ = 2.06, $F_{2,36}$ = 1.31), nor for adults captured in summer and those captured in winter ($F_{1,28}$ = 0.08, $F_{1,30}$ = 1.256, $F_{1,32}$ = 0.05). Also, the sum of burrow and rock depth showed no significance for adults between summer and winter ($F_{1,26}$ = 1.73). In fact, in rocky areas, burrow depth often appeared to be a reflection of soil depth. Note that sample sizes are not equal for each subset of data, as damage to the collecting area often precluded the measurement of all variables.

Other animals were often found under the same rock as a lizard, but not in the same burrow. These animals included lizards of the same and different species (*Lampropholis delicata* and *L. guichenoti*). centipedes, snails, termites and a number of ants of both carnivorous and granivorous species.

Burrow temperatures showed considerable daily and annual variation, and were dependent on burrow depth. Figure 2 details some examples of diel fluctuations found throughout the year in burrows under rocks 4 and 40 cm deep. In all cases body temperatures of

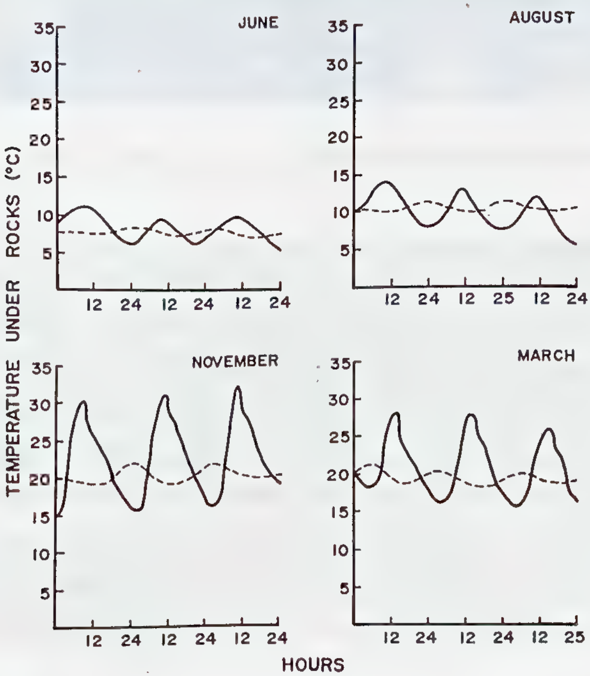

Figure 2: Daily temperature fluctuation under rocks 4cm (—) and 40 cm(----) deep. Examples only are presented.

inactive lizards reflected the surrounding burrow temperatures.

The lizards, when inactive in burrows, were usually in a curled position with the tail bent towards the head, and the fore and hind limbs pressed against the body with the fore and hind feet held against the dorsal surface (Fig. 3). This position could be an attempt to minimise heat or possibly water loss, although the second alternative is unlikely as throughout the drought of 1979-82 when soil moisture levels were very low the majority of lizards were found in the early morning with a covering of dew on their bodies.

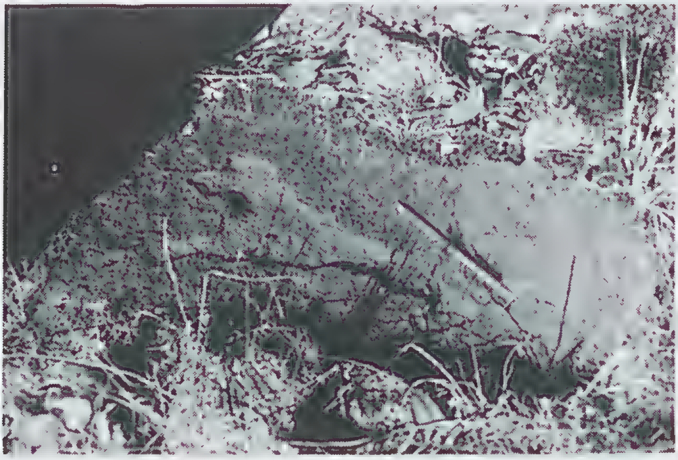

Figure 3: Inactive *Ctenotus taeniolatus* in burrow. Note position of limbs and tail.

Discussion

In the New England Tablelands, a region with below zero air temperatures in winter and an average of 200 frosts a year (Hobbs and Jackson 1977), exposure to low temperatures could be detrimental to the survival of *C. taeniolatus.* However, although many studies (review by Gregory 1982), including the present one, show that deeper underground sites have higher and more stable temperatures than do surface ones, C.taeniolatus does not appear to actively make use of this phenomenom, for within rocky habitats of New England *Ctenotus* is not very selective. This lizard shelters under rocks of any size resting on an amount of soil suitable for burrow construction. Also, the size and shape of the burrow is determined primarily by depth, and presumably the type of soil available and does not vary consistently with lizard sex or time of the year. Thus, in the cold of winter or the heat of summer, lizards do not dig significantly different or deeper burrows.

Further, although lizards maintain body positions that could minimise heat loss this trend is not extended to include the occurrence of lizard aggregations during winter as occurs in the genus *Lampropholis* (Powell *et al* 1977), for lizards were very rarely found together under the same rock and never in the same burrow. Other animals that were occasionally found under the same rock were never found within the same burrow as the lizard.

Acknowledgements:

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THE OCCURRENCE OF THE CHILDRENS PYTHON *(Liasis childreni)* ON DIRK HARTOG ISLAND, W.A.

BY BRADFORD MARYAN, 593 METCALFE RD. LYNWOOD 6155

On the 27th May 1982 at approximately 2200 hours I collected a male Childrens Python near the main homestead on Dirk Hartog Island W.A. (26°09 S 113°11 E).

The specimen was found between sheets of iron on a sandy soil. Vegetation in the area consisted of *Acacia sp., Spinifex longifolius* and shrubs such as *Oleria axillaris* and *Myoporum insulare.*

The Western Australian Museum confirmed that this was only the second record of *Liasis childreni* from Dirk Hartog Island.

Other reptiles found on the island during the trip were:-

Snakes
Hydrophis elegans
Demansia olivacea calodera
Demansia reticulata (Reticulated Whip snaka)
Vermicella littoralis (Desert Banded snake)
Skinks
Egernia stokesii badia (Spiny tailed skink)
Ctenotus fallens
Omolepida branchialis
Menetia greyii
Cryptoblepharus carnabyi
Morethia linoocellata
Lerista elegans
Lerista lineopunctulata
Dragons
Ctenophorus reticulatus (Western Netted Dragon)
Ctenophorus maculatus (Spotted Dragon)
Ctenophorus parviceps
Geckos
Diplodactylus ornatus
Crenadactylus occelatus horni (Clawless gecko)
Nephrurus levis occidentalis (Knob tailed gecko)
Underwoodisaurus milii (Barking gecko)
Gehyra variegata
Heteronotia binoei (Bynoes gecko)

NOTES ON THE REPRODUCTION OF THE BEARDED DRAGON *Pogona minor.*

Robert Browne-Cooper, 9 Rankin Rd., Shenton Park, W.A. 6008

On the 9th September at 16.20hrs, I observed a Western Bearded Dragon (*Pogona minor*) depositing a clutch of eggs, in the Perth metropolitan area (32°00 S 115°48 E). The dragon was found in a shallow, angled hole approximately 250mm deep which appeared to be entirely refilled except for a narrow hole, presumably for air. The eggs were deposited in moist, grey loamy soil and the hole was situated on a track. The exact number of eggs is unknown as counting would have disturbed them, although 5 plus eggs could be seen. Eggs measured approximately 10mm by 15mm and were leathery shelled. The vegetation of this area consists mainly of Jarrah-Banksia woodland.
The specimen had a snout-vent length of 113mm and a vent-tail length of 192mm.

POPULATION OF *NOTECHIS CORONATUS* (CROWN SNAKE) AT POISON CREEK

John McGovern, 75 Blue Bush Rd, Kambalda West, WA 6444

Poison Creek (33°26' E, 123°26 N) is approximately 175km from Esperance, and approx. 15km from Cape Arid. Most of the landscape is now bare sand dunes, due to a recent fire which burnt most of the scrub and bush. There are several granite outcrops which form small rocky hills.

On the 6th June, 1983 I found 20 specimens of *Notechis coronatus*, (formerly *Elapognathus*) over an area of 5km. All snakes were found under rock slabs on the rocky hills. Most of the snakes found were adults or sub-adults (12 adults: 6 sub-adults: 2 juveniles). The *N. coronatus* are possibly using the rocks as cover because of the loss of vegetation in the area.

Very few reptiles apart from *N. coronatus*, and *Ctenotus labillardieri* were found. I noted two juvenile *Pseudonaja affinis*, and several *Hemiergis peronii*.

Ctenotus labillardieri probably form a large part of the diet of *N. coronatus* as 53 of these skinks were recorded.

OVIPARITY IN THE ELAPID *Cacophis squamulosus*

Theo Tasoulis, 33 Frederick St, Dudley 2290

On the 3rd January, 1983 the author collected an adult *Cacophis squamulosus* (SV : 540mm) at 21.00 hours foraging on the road in the Chichester State Forest. The specimen was caught in a gully of wet sclerophyll forest. It was believed to be gravid and retained in captivity for observation. No interest was shown in sub-adult Water Skinks *Sphenomorphus quoyii*, offered as food, although a previous specimen kept by the author devoured skinks readily. On the 11th January, 1983 it deposited 4 large, elongated white eggs. Considering the date of capture and the small size of the clutch in comparison to data presented by Wells (1980) it is possible that part of the clutch had been laid before capture.

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AN OBSERVATION OF A DISPLAY OF AGRESSIVE BEHAVIOUR BETWEEN TWO MALE TUSKED FROGS (*ADELOTUS BREVIS*).

By Stephen Giddings, 122 Philip Highway, Elizabeth South S.A.

In October, 1976 I collected a pair of Tusked Frogs (*Adelotus brevis*) from Lismore NSW.

The Tusked Frogs were housed in an indoor glass vivarium, 460mm H x 610 L x 380mm W. Aslo housed in this vivarium were two other species, some Spotted Grass Frogs (*Limnodynastes tasmaniensis)* and three Brown Tree Frogs, (*Litoria ewingii*).

The vivarium had a large shallow tray, which took up half the vivarium. Some flat shale rocks were in this tray to provide crevices. The landscape was decorated with moderate rockery of live plants. For a while the frogs all appearedcompatible, until I found a Tusked Frog trying to eat one of the Brown Tree Frogs, after which the Tusked Frogs were housed on their own. Their vivarium was decorated in a similar manner to their previous vivarium.

In September, 1977 the Tusked Frogs were sexed as males. In December 1978 I received a female frog, which I placed it with the two males. Occasionally the frogs could be heard calling, but would stop when I entered the room.

One day when I entered the room, I observed the two males struggling in the water tray. They had hold of each other mouth to mouth. When I approached the vivarium for a closer look, the frogs separated and swam off in opposite directions. One of the males climbed out of the water, and hopped to a crevice and hid.

Sometimes, the males or a male would attempt to clasp the female. The female would always escape and hide. Again, I observed the males biting each other mouth to mouth. This lasted a few minutes before they released each other.

A short time after these observations were made, we had a bad heat wave and the Tusked Frogs were lost. Unfortunately I have been unable to replace these frogs and have therefore been unable to make any further observations.

Acknowledgements:

I would like to thank Mr Harry Ehmann for obtaining the female Tusked Frog, and for encouraging me to write this article.

PREDATION OF THE MEDITERRANEAN BEETLE *Blaps polychresta* BY THE WESTERN BLUETONGUE LIZARD *Tiliqua occipitalis*

Bryan Roberts, 14 Thirza Ave., Mitchell Park, S.A. 5043.

On the 31st JANUARY 1982, the SAHG collected an adult *T. occipitalis* at Pt. Parham, S.A., (34°25'S 138°16'E). Shortly after capture the lizard defecated and, obvious in the faeces, were the shell remnants of several *B. polychresta.*

Ehmann (1982) suggests that *B. polychresta* is a potential poisonous prey to Tiliqua species, due to its irritating anal secretion.

This instance of *T. occipitalis* preying on *B. polychresta* raises doubts as to the classification of *B. polychresta* as poisonous to members of the Tiliqua genus.

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UNUSUAL DEFENSIVE BEHAVIOUR BY *DELMA AUSTRALIS* IN CAPTIVITY AND IN THE WILD

Bradford Maryan, 593 Metcalfe Rd, Lynwood WA 6155

On the 28th August, 1983 a captive *D. australis* was observed propelling its entire body into the air three times. Upon investigation it seemed that the lizard was startled by the presence of a *Lialis burtonis.* The leaps took place over a period of about 3 to 5 seconds. The lizard was extremely agitated afterwards, moving around the vivarium before taking refuge undercover.

I have observed this species performing these leaps in the field which sometime makes capture difficult. Such behaviour could confuse a predator sufficiently to allow escape.

I have yet to observe this behaviour in other species though a specimen of *Delma fraseri* I found did perform minute leaps. Similar behaviour has been observed in *Delma grayii,* the behaviour being more of a convulsive wriggling display than leaping in the air.

Acknowledgements

I would like to thank Mrs Betty Wellington of the Perth Museum for information on her own observations of the defence behaviour in Delma australis in the field.

PETER RANKIN TRUST FUND FOR HERPETOLOGY
CALL FOR APPLICATIONS

Applications are now being called for the fourth round of grants-in-aid to be awarded by the Peter Rankin Trust Fund for Herpetoloty. Individual grants will be in the range $50.00 to $1,000.00. The closing date for applications is 30th September, 1985. It is expected that awards will be announced by 31st October, 1985.

Applicants must be resident in Australia and must not already hold a professional appointment. Preference will be given to young, relatively inexperienced people with a beginning interest in reptiles and amphibians.

Applications should include the following information:

- Applicant's name and permanent address.
- A brief outline of the project.
- A brief budget, specifying (a) travel and field costs; (b) equipment; and (c) miscellaneous (with brief explanation).
- Proposed date of completion.
- The names of two people to whom the Selection Committee may refer if necessary.

Applications should be sent to:

The Peter Rankin Trust Fund for Herpetology
The Australian Museum
P.O. Box A285
SYDNEY SOUTH, N.S.W. 2000

In accepting an award, successful applicants wil thereby agree to the following:

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- To submit a brief report within one month of the completion date.
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NOTES TO CONTRIBUTORS

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